Structural Organisation of the Body

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Overview

Nature has created specific cells for specific organs and tissues of the body in order to perform specific functions. A human cell determines the type, nature and function of the tissues and organs. Each nerve, muscle, bone, cartilage, connective tissue, skin and mucous membrane is dependent on the harmonious balance of the qualities of heat, moistness, coldness and dryness in relation to its ideal qualitative state.

The body is made up of different tissues and organs, which enable it to support the various structures and functions. Soft tissues connect, support, or surround other structures and organs of the body; whereas hard tissues support the frame of the body.

Epithelial tissue covers, lines and protects organs. Connective tissue binds and connects structures, offers protection, and stores energy as fat. Muscular tissue has the ability to shorten or contract in order to produce movement of the body parts. Nervous tissue initiates and transmits nerve impulses to coordinate physiological functioning.

The Human Organism

The basic structure and functional organisation of the human body can be thought of as a pyramid or hierarchical arrangement in which the lowest level of organisation (the foundation) consists of cells and chemicals. Organs and organ systems represent the highest levels of organisation.

Organisational level is referred to as the ***human organism,*** which is made up of many types of organ systems.

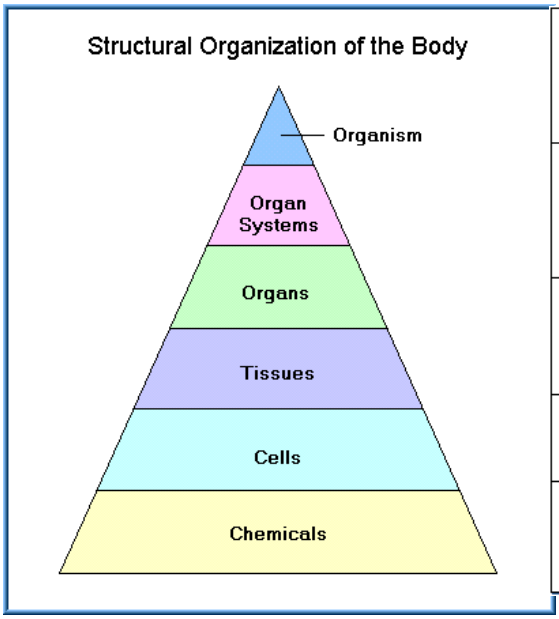
An **organ system level** is referred to as the ten ***organ systems,*** which consist of different organs that work closely together.

An **organ level** is referred to as ***organs,*** which are made up of different types of tissues.

Tissue level is referred to as ***tissues,*** which consist of similar types of cells. Tissues are located between the cell and organ levels.

Cellular level is referred to as ***cells*** which are made up of molecules.

Chemical level is referred to as ***atoms*** which combine to form molecules.[1]



Organ systems	A group of organs that contribute to specific functions within the body. ***Examples:*** *gastrointestinal system, nervous system*
Organs	A group of tissues precisely arranged so that so they can work together to perform specific functions. ***Examples:*** *liver, brain*
Tissues	A group of cells with similar structure and function. There are only four types of tissues: epithelial tissue, connective tissue, muscle tissue, and nerve tissue.
Cells	The smallest living unit in the body. ***Examples:*** *hepatocyte, neuron*
Chemicals	Atoms or molecules that are the building blocks of all matter. ***Examples:*** *oxygen, protein*

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Elements

> The basic constituents of the human body are the elements of ***fire*** (hot and dry), ***air*** (hot and moist), ***water*** (cold and moist), and ***earth*** (cold and dry), and which comprise the basic units of a compound. The various compounds in nature depend on their chemical combinations for their existence.

An element is a member of a group of basic substances that give rise to everything that exists. An element is any of the primary parts or constituents of a thing. In chemistry, an element is a simple substance which cannot be decomposed by chemical means, and which is made up of atoms, which are alike in their peripheral electronic configurations, chemical properties and in the number of protons in their nuclei. The number of neutrons in their nuclei, the atomic weight, and their radioactive properties, may differ.[2]

Tibb recognises that the chemical properties of the elements depend upon their specific form.

> The specific ***form*** is that property of matter which determines its internal ***structure,*** which is specific for that particular ***matter.***

Any change in the specific form results in a change in its chemical properties. Thus the specific form of the elements is the atomic structure, which depends upon the atomic number.

No two elements carry the same atomic number, just like no two human beings have the same humoral composition. Likewise, the specific form of a compound depends upon the molecular structure of that compound, just like the unique temperament, which is

dependent on the ratio and quantity of the qualities of heat, moisture, coldness and dryness.[3]

Matter and Atoms

The fundamental constituent of ***matter*** is quarks, which form electrons, protons and neutrons. Atoms form elements and compounds, which gives rise to cells – the basic unit of the body.

- ***Organic substances*** comprise: proteins, carbohydrates, lipids and nucleic acids.
- ***Inorganic substances*** comprise: minerals and water.

An ***atom*** is the ***smallest*** particle of an element that is capable of entering into a chemical reaction. A ***compound*** is made up of ***two or more parts*** or ingredients. In chemistry, a compound is a substance that consists of two or more chemical elements in union.[2]

Just as the ***atom*** is the unit for the ***outer environment,*** so ***cells*** are the basic unit for the ***inner environment*** of man and all living entities. The same type of cells with the same type of temperament, structure and function combine to form ***tissues,*** the combination of which forms ***organs.*** Ultimately from the cells, tissues and organs, the overall ***shape,*** form and structure of the body is obtained. Each level, be it cell, tissue, organ or the total human being (body, mind and soul), is assigned a ***specific temperament.***

Distribution of Components that make up the Human Body

Scientists believe that about 25 of the known elements are essential to life. Just four of these – carbon, oxygen, hydrogen, and nitrogen, make up about 96% of the human body.

Oxygen makes up ***61%*** of the body's mass. Oxygen is essential to life as it is a component of DNA and most important compounds in the body. Oxygen is present in the body mostly as water so the actual amount may vary.

Water makes up about ***65%*** of the total body mass. On inhalation, oxygen is absorbed through the lungs and picked up by the iron in the red blood cells. From there, it is carried to wherever it is needed throughout the body.

Carbon makes up ***23%*** of the body mass. Carbon's stability makes possible the long chains and rings of atoms that form everything from the DNA to the steroids and proteins in the body.

Hydrogen makes up ***10%*** of the body mass, and it's most important role is as a component of water (H_2O). Water carries nutrients to the cells and removes toxins from the environment. Almost all reactions in the body take place in water. A person needs about 2.5 litres of water every day to keep healthy, unless it is medically contraindicated. About half

of this comes from the liquids one drinks, and half from food. Without hydrogen, one would not be able to digest food. Hydrochloric acid is a compound of hydrogen and chlorine.

Nitrogen makes up ***2.6%*** of the body's weight. It is a component of DNA, as well as haemoglobin that carries oxygen in the blood. It is also a component of amino acids that form enzymes and other proteins. Nitrogen is important for growth, especially during pregnancy. Although the air one breathes contains plenty of nitrogen, one does not absorb it in this form. Instead, one gets most of the nitrogen from food.[5] Many foods contain nitrogen, especially protein sources such as meat and dairy products.

Calcium accounts for about ***1.4%*** of the body mass. Calcium is a metal, and the most abundant metal in the body.

Calcium is mostly found in bone, and it also controls cell division, aiding in the conduction of nerve impulses and contraction of muscles, and keeping blood pH stable. It is also important for blood clotting.

Phosphorus makes up about ***1.1%*** of the body mass. In the form called white phosphorus, it is highly flammable and poisonous. Luckily, in the natural world phosphorus is found only in the form of phosphate, which is a phosphorus atom bonded to four oxygen atoms.

Although it is a small component of DNA, phosphorus is found in the body mostly as calcium phosphate in bone. Phosphorus also makes it possible for the body to move.

When the energy molecule, adenosine triphosphate (ATP), releases a phosphate molecule, this creates the energy needed for contracting muscles. The body creates, uses and recycles about one kilogram of ATP every hour.[5]

Cells of the Body

> Each system of the body is dependent upon the harmonious interplay of organs and tissues.

It is at the **cellular level** that one can most fully appreciate the functioning or malfunctioning of the systems of the body.

By understanding the integral parts of the cell, one can get a better grasp of its basic function as well as its overall contributions to tissues and organs as a whole.

Cells are composed of water, inorganic ***ions,*** and carbon-containing (organic) ***molecules.*** Water is the most abundant molecule in cells, accounting for 65% or more of total cell mass, depending on the age of a person. The percentage of water in infants is much higher, typically around 75-78% water, dropping to 65% by one year of age.

The **inorganic ions** of the cell constitute 1% or less of the cell mass, including sodium, potassium, magnesium, calcium, phosphate, chloride, and bicarbonate. These ions are involved in a number of aspects of cell metabolism, and thus play critical roles in cell function.

The **organic molecules** are, however, the unique constituents of cells. Most of these organic compounds belong to one of four classes of molecules: carbohydrates, lipids, proteins, and nucleic acids.

The Basic Unit of Tissue

A ***human cell*** is the ***basic unit of any tissue,*** which determines the ***type,*** the ***nature*** and ***function*** of the tissues. A group of different types of cells form tissues, and one or more types of tissues form organs. The organs work together in unison the body, which make up the organ systems.

> All living organisms are made of individual and identifiable cells, whose number, together with their size and type, ultimately defines the structure and functions of an organism.[4]

There are specific cells for specific organs and tissues of the body. The difference in the cells is largely determined by the type and composition of the inorganic salts which make up a cell. If the body or any tissues of the body is burned, it leaves behind ashes, which are the inorganic constituents of the body.[5]

Continuum of the Species

Each nerve, muscle, bone, cartilage, connective tissue, skin and mucous membrane is dependent on the correct balance of the molecular motion and structure of the mineral salts and water content in the body. Any disturbance in this equilibrium results in abnormal conditions, which are known as disease.

> The cells of the body will function to its optimal capacity when the ***internal and external environment is in harmony*** with one another. Physis will assist in the elimination of any excess of material in the body, and it will assimilate the necessary nutrients.

Just as the atom is the unit for the outer environment, so cells are the basic unit for the inner environment of man and all living entities. The same type of cells with the same type of temperament, structure and function combine to form tissues, the combination of which forms organs. Ultimately from the cells, tissues and organs, the overall shape of the body is obtained.

In Tibb, each level, be it cell, tissue, organ or the total human being (body, mind and soul), is assigned specific combinations of the qualities of heat, moistness, coldness and dryness.

Survival in the continuum of the species involves the efficient functioning of the reproductive system of the body. In Tibb the Generative faculty is responsible for the propagation of the species and the continuity of life. The Gonads originate from the ***endoderm,*** and it regulates the ***reproductive*** system, which requires its optimal qualitative state of ***heat and moisture*** for the growth of the foetus.[6]

Inside and Outside the Cell

> The cell is delimited by a **lipid/protein-containing membrane,** which serves as critical recognition ***sites for hormones,*** as well as for the ***movement of molecules*** in and out of the cell.

Within the cell is another membrane-bound site called the **nucleus,** which houses the genetic information of the organism. The DNA molecules contain about 70,000 genes which provide coded instructions on how the cell is to make protein, the latter which gives the cell it's function, for example: the liver cells make liver proteins, and the heart cells make heart proteins, etc.

Outside of the nucleus is a complex membrane structure called the **endoplasmic reticulum** which serves as a work-bench to construct proteins under instructions from the genetic DNA code. Also within the cell are small, **membrane organelles called mitochondria**. These organelles are responsible for generating ATP energy for all of the cell's processes by metabolically breaking down glucose and fat.[7]

Types of cells are based on the tissues they form:

- Bone cells are held together by calcium and phosphate. They support the framework of the body by forming the organs on the skeletal system, such as the bones.
- Cartilage cells are flexible and loose, and are present in between the bones to assist them in bending, such as in the joints or between the ribs.
- Nerve cells are found in the brain and spinal cord, which form the nervous system.
- Epithelial cells form the covering layers of all the organs, such as the skin.
- Muscle cells provide movement by means of contraction and relaxation, namely the skeletal, cardiac and smooth muscles.
- Secretory cells are responsible for secretion of substances in all the secretory organs, such as the secretion of insulin by the cells of the pancreas.
- Adipose cells store fat in the body, and reduce friction of the body, such as in the buttocks of soles of the feet.
- Blood cell analysis shows that blood contains organic constituents (sugar, fat, albumin), and inorganic constituents (water and certain minerals, commonly called cell salts). Of a living human being, water constitutes over seven-tenths, and the cell salts about one-twentieth; while organic matter, the remainder.[8]

Types of cells are based on their functions:

- Conductive cells conduct electric impulses from one region to another in the body, such as nerve and muscle cells.
- Connective cells connect other cells and tissues together, such as bone and blood cells.
- Glandular cells form the glands in the body, which are responsible for secretion, such as the pancreas and salivary glands.
- Storage cells store materials for use at a later stage, such as adipose cells.

- Supportive cells support adjacent cells, such as the Glial cells in the brain and spinal cord, which serve to nourish the nerve cells and to protect them from shocks and trauma.
- Sperm cells and oocytes are responsible for procreation and preservation of the species.
- Rods and cones are cells in the eyes, which capture colour and light.
- Ciliated cells line the respiratory tract, oesophagus, etc., which are made up of cilia, which help to expel unwanted material from the body.[9]

Minerals in the Body

Mineral salts are the material basis of the organs and tissues of the body, and are absolutely essential to their integrity of structure and functional activity. They are the physical basis of all healing, and if the mineral salts are absent from the blood and tissues, no permanent cure is possible.[10]

Minerals are **inorganic** compounds, whereas ***carbohydrates, proteins, lipids and vitamins*** are all **organic** compounds. They do not yield any energy. Minerals are not readily destroyed by heating or cooking of food, but they can leak out into the liquid or water that the food is cooked in, thereby reducing the mineral content if the liquid is discarded.

Organic substances comprise: proteins, carbohydrates, lipids and nucleic acids.
Inorganic substances comprise: minerals and water.

Each cell is made up of an infinitesimal but perfectly balanced quantity of three classes of material – water, organic substances and inorganic substances. Water and organic matter make up the greater portion of the body. The inorganic mineral elements however, although present in much smaller quantities, are really the most important active elements because they utilise organic substances to build the millions of cells of which the body is composed.[11]

Functions of Minerals include involvement in:

- Nervous system functioning;
- Cellular reactions;
- Water balance in the body, and
- Structural systems, such as the skeletal system.

Tissues of the Body

A ***tissue*** is an aggregation of ***similarly specialised cells*** which are united in the performance of a particular function. The group of cells that make up a tissue have physiological functions that work together in a coordinated way to support special functions. The special function of a tissue is also influenced by the kind of material that surrounds the tissue, and by communication among the cells of the tissue. Different kinds of tissue have different physical properties. Tissues may be hard (bone), soft (muscle), or even liquid (blood).[12]

In the structural organization of the body, tissues are located between the cell and organ levels of organisation. Individual cells are a lower level of organisation. Tissues are made up of many individual cells. Groups of different kinds of tissues are organised together to form organs, which have special functions with characteristic shapes and functional properties.

There are four kinds of tissues that make up the human body, which are based on differences in their anatomy and functions, namely: nervous, muscular, epithelial and connective tissues, which work synergistically with the brain, heart, the liver and the skeleton, respectively.

- **Epithelial tissue** is made of layers of cells that are joined together and may ***cover*** the surface of the body (epidermis of the skin) for ***protection, lines*** cavities (such as lining of the abdominal cavity) and hollow structures (lining of blood vessels), or form glands (sweat glands).
- **Connective tissue** is usually made of cells and extracellular fibres that ***binds*** or holds structures together (tendons), ***protects*** them (cartilage), ***stores energy*** (fat), and stores minerals, or produces blood.
- **Muscular tissue** is made of cells that are organised to shorten and produce force when they contract (smooth skeletal), to ***produce movement;*** muscles relax when they are at rest.
- **Nervous tissue** is made of neurons and accessory cells, which initiates and ***transmits nerve impulses*** to coordinate physiological function. Neurons are the cells that carry information to the rest of the body. Accessory cells protect and support the function of neurons.[12]

Functional Units of the Body

Various types of tissues can combine to form functional units called ***organs,*** such as the heart, the brain, and the liver. Organs may interact to form ***organ systems*** such as the digestive system, where multiple organs work in unison to perform a single function, like digestion.

From molecules to cells to tissues to organs to organ systems to a body, each part of the body has properties that depend on its subunits.[13]

The nervous, muscular and epithelial tissues bind together with the help of the connective tissue, to make up the organs of the compound body, such as the stomach, intestine, lungs and kidneys. All these compound organs can be classified in three **basic groups of organs,** based on having proportionally more tissues of the particular type.

Nature has remarkably created the body in such a way that the organs, which control physiological functioning, are first formed, namely:

- The ***nerves*** are at the top, and are responsible for ***sensation;***
- The ***glands*** are in the middle, for supplying the ***food,*** and
- The ***muscles*** are at the bottom, and control all kinds of ***movement.***[14]

The human body is composed of three types of tissues, namely:

- ***Ectodermic*** tissues, which build ***nerves,*** and their centre is the ***brain.***
- ***Mesoderm*** tissues, which build ***muscles,*** and their centre is the ***heart.***
- ***Endodermic*** tissues, which build ***epithelial*** cells, and their centre is the ***liver.***[15]

Soft and Hard Tissues

In anatomy, **soft tissues** are the tissues that connect, support, or surround other structures and organs of the body. Example include: tendons, ligaments, fascia, skin, fibrous tissues, fat, and synovial membranes, as well as muscles, nerves and blood vessels. Soft tissue contains ***moisture,*** which enables conduction of blood, nutrients, nerves, as well as offering flexibility and movement.

Hard tissue comprises bone, which forms the skeletal structure. It has ***cold and dry*** qualities, which gives it the stiffness needed to support the frame of the body.

Conclusion

By understanding the integral parts of the cell, one can get a better grasp of its basic function as well as its overall contributions to tissues and organs as a whole. The same type of cells with the same qualitative state, structure and function combine to form tissues, the combination of which forms organs. Ultimately from the cells, tissues and organs, the overall shape of the body is obtained. The organs work together in unison the body, which make up the organ systems.

Each nerve, muscle, bone, cartilage, connective tissue, skin and mucous membrane is dependent on the correct balance of the molecular motion and structure of the mineral salts and water content in the body. Any disturbance in this equilibrium results in abnormal conditions, which are known as disease.

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